# METHOD INCORPORATING COMPUTER-IMPLEMENTED STEPS, A COMPUTING DEVICE, A COMPUTER READABLE STORAGE MEDIUM, AND A CLIENT COMPUTING DEVICE FOR MODELLING THE ALIGNMENT OF AN ORTHOPAEDIC IMPLANT FOR A JOINT OF A PATIENT

## RELATED APPLICATIONS

This application is a divisional of U.S. patent application Ser. No. 14/000,858, filed on Aug. 21, 2013, issued as U.S. Pat. No. 8,983,813 on Mar. 17, 2015, and entitled COMPUTER-IMPLEMENTED METHOD, A COMPUTING DEVICE AND A COMPUTER READABLE STORAGE MEDIUM FOR PROVIDING ALIGNMENT INFORMATION DATA FOR THE ALIGNMENT OF AN ORTHOPAEDIC IMPLANT FOR A JOINT OF A PATIENT which is the National Stage of International PCT/AU2012/000179, filed on Feb. 24, 2012 which claims the benefit of Foreign Patent Application AU2011900673, filed on Feb. 25, 2011, the disclosure of which is incorporated by reference herein.

## FIELD OF THE INVENTION

The present invention relates to a method comprising computer-implemented steps, a computing device, a computer readable storage medium, and a client computing device for providing alignment information data for modelling the alignment of an orthopaedic implant for a joint of a patient.

The invention has been developed primarily for use in modelling the alignment of an orthopaedic implant for a knee or hip joint of a patient, and providing tools for assisting with the modelling of the alignment of an orthopaedic implant for a knee or hip joint of a patient, and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular field of use.

## BACKGROUND OF THE INVENTION

Replacing joints with orthopaedic implants due to injury or degeneration has been commonplace for many years. A more fitness-driven outlook and active lifestyle pursued by the older generation is giving rise to an increasing frequency of joint degeneration or injury from an earlier age.

As such, joints, such as knee and hip joints, must be surgically repaired or, in some cases, totally replaced. The current method for replacing joints typically involves mechanical axis alignment of a joint for placing the orthopaedic implant. This involves taking a number of stationary physical measurements to align the orthopaedic implant to the patient's primary mechanical weight bearing axis. For example, for a knee joint, this involves aligning the orthopaedic implant based on a mechanical weight bearing axis that intersects the centre of the hip, the centre of the knee and the centre of the ankle.

Current standard surgical practice is to use instruments (mechanical and computer driven) to align implants to reference points. The mechanical axis in knees and an analogous geometrical reference frame in hips is used (for example, 45 degrees cup inclination, 15 to 20 degrees cup ante-version, neutral femoral stem position).

It is also known to try to adjust the range of motion of the joint by varying the implant position. This is either done manually, through the expert handling/feel of the surgeon, or, through the computed identification of a central axis of the range of motion.



It is also noted that commercially available computer navigation systems currently provide information about mechanical alignment and the ability to customize implant position from this information.

Total joint replacements that are aligned using mechanical axis alignment, although showing favourable results for survivorship and longevity, are often disappointing when measured in terms of functional patient outcomes. That is, the joints are not suited to activities that a person may wish to undertake, therefore causing pain and discomfort to the person. In some cases, such activities will cause the implant to fail.

People with total joint replacements rarely achieve the lifestyle equivalents of their non-arthritic peers. As such, there is a lack of techniques that demonstrate improvements in patient function and quality of life, after a total joint replacement.

The problems mentioned above can be attributed to the lack of patient specificity offered by 'off the shelf' orthopaedic implant designs. All patients receive the same implant designs in the same position regardless of their age, gender, activity level or body shape. However, not all patients are the same.

Patient diversity has recently received much attention within the orthopaedic literature. A topical example is the difference in the size of male and female knees. This has led total knee replacement (TKR) manufacturers to introduce separate size ranges for male and female implants.

This only goes some of the way to addressing the diversity encountered by orthopaedic surgeons in practice today. Many published studies highlight many more morphological differences that exist within sampled patient populations.

A pertinent example is that of the slope of patients' tibial plateaus. Males have been measured on average to have significantly different posterior slopes to that measured in females. Furthermore, there has been significant inter-sex variation observed. Yet manufacturers recommend to surgeons implanting knee replacements that they align the tibial components with a one size fits all 'standard' recommended prostheses alignment. This alignment recommendation does not change if you are male or female, whether you have a severe tibial slope or a mild tibial slope, whether you are short or tall, or whether you have a high or low demand lifestyle.

This is not just the case for tibial component alignment. All of the alignment parameters generally recommended to surgeons are one size fits all generalisations. This one size fits approach to TKR surgery contributes to the relatively poor functional outcomes.

Similar generalisations can be found in the hip replacement arena. The 'gold standard' acetabular cup position for all patients is defined to be forty-five degrees of inclination and twenty degrees of ante version with reference to the anterior pelvic plane. This standard alignment becomes inappropriate when a patient presents with an anatomical variation, such as, pelvic tilt, pelvic mobility or pelvic stiffness.

Examples of processes for achieving mechanical axis alignment in total knee replacement surgery using imaging data and rapid prototype manufacturing techniques include: Prophecy™ (Wright Medical Technology, Inc.), Trumatch™ (DePuy Orthopaedics, Inc. a Johnson & Johnson Company), Signature™ Personalized Total Knee Replacement (Biomet, Inc.), MyKnee™ (Medacta, International SA), Zimmer™